ACCUMULATION OF HEAVY METALS IN *VICIA FABA* BEANS

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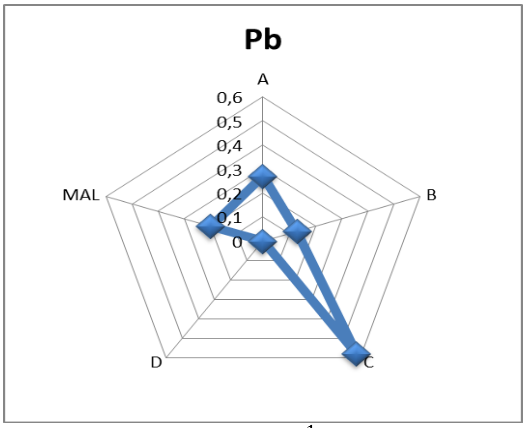
Abstract
The levels of heavy metals like lead, cadmium, zinc, chromium, iron, nickel etc., were examined in *Vicia faba*beans(broad beans) sold in supermarkets from Timisoara, Romania.
The beans have been analyzed for fife heavy metals (Pb, Cd, Cu, Ni and Zn) using AAS. Research findings show that some of the samples present contamination with lead, cadmium and a very high content of nickel. Statistical analysis reveals the tendency of broad beans to be a good bio accumulator of nickel.

Introduction
Vicia faba L is one of the oldest crops grown by man, used as a source of protein in human diet, as fodder [1] and forage crop for animals, and for available nitrogen in the biosphere [12]. Faba beans are the best source of vegetable protein legumes [10]. It is well known that replacing meat with legumes decreases saturated fat in the diet and reduce cardiovascular risk [12].
Lead (Pb), Cadmium (Cd), Copper (Cu), Nickel (Ni) and zinc (Zn) are heavy metals which are affecting the plants differently, being essential elements for cellular metabolism (Cu, Zn, Ni) and also considered as non-essential (Cd, Pb).

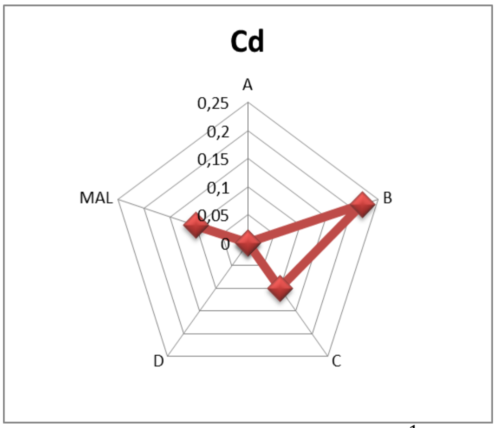
Experimental
Samples collection and preparation
Vicia faba beans samples were collected from four local supermarkets.
The collected *Vicia faba* beans were washed with distilled water to remove dust particles and were oven dried at 105°C to constant weight and prepared for analysis as described by Bordean D.M.et al, 2012 [2]. All glass wares and containers required for experimentations were first washed with distilled water followed by soaking in 10% nitric acid for few hours.
Heavy metal analysis
The heavy metals content in *Vicia faba beans* was carried out in HNO_3 solution resulted by ash digestion [2, 9]. The dry ash process was carried out in a muffle furnace by increasing the temperature stepwise of up to 550°C and then keeping at this temperature for 4.30 hours. The metal content in the in the obtained solutions were determined by flame atomic absorption spectrophotometry and were expressed as $mgkg^{-1}$ d.w. (dry weight).
Statistical analyses were performed by using MVSP software package.

Results and discussion
The results of the heavy metals performed analysis are presented in figure 1.
According to the data, the studied heavy metals concentrations seem to be similar to the values present in analyzed *Vicia faba* beans originated from other countries and are under the recommended maximal limit (*table 1*), for copper and zinc content. Two of the analyzed samples present high content of lead (A: 0.27 [$mgkg^{-1}$ d.w] respectively C: 0.58 [$mgkg^{-1}$ d.w]) and one sample presents contamination with cadmium (B: 0.22 [$mgkg^{-1}$ d.w]). Interesting is the high content of nickel in three of the samples (A, B and C).

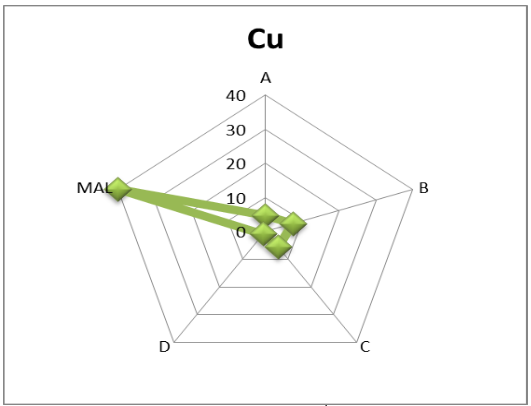
According to Ghosh et al, 2013 [8], the presence of Nickel ranges from 0.200 to 5.833 ppm in various vegetables, while Cempel M and Nikel G, 2006 consider that “Nickel levels in foodstuffs generally range from less than 0.1 mg/kg to 0.5 mg/kg” [3].
The high content of Ni in beans is confirmed by Sharma AD., 2013 which affirms that legumes like beans, peas, lentils, peanut, soya beans and chickpeas are “foods with high nickel content irrespective of the soil content” [11].



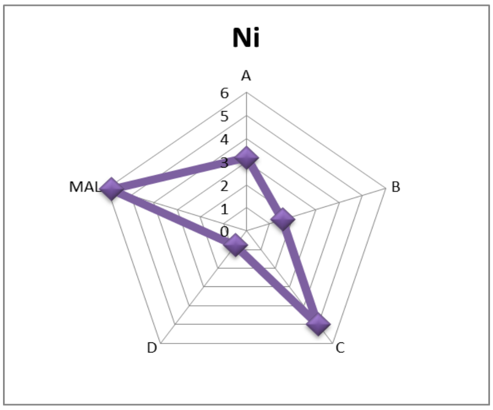
Lead content [mgkg^{-1} d.w.] in broad beans



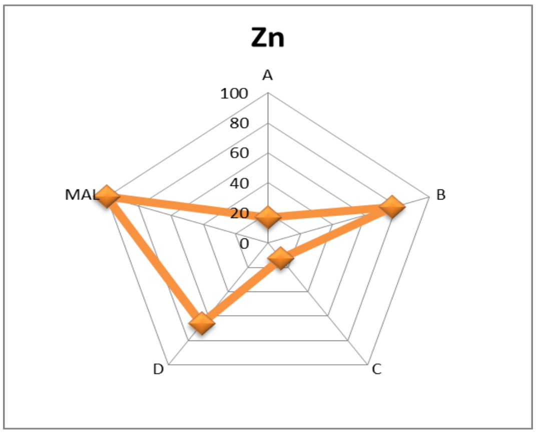
Cadmium content [mgkg^{-1} d.w.] in broad beans



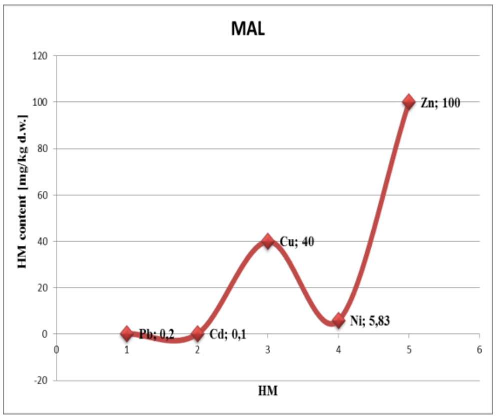
Copper content [mgkg^{-1} d.w.] in broad beans



Nickel content [mgkg-1 d.w.] in broad beans



Zinc content [mgkg-1 d.w.] in broad beans



Maximum allowable limits (MAL) in vegetables

Figure 1. Graphical representation of heavy metal content in *Vicia faba* beans

Legend: A, B, C, D = the supermarkets from where the *Vicia faba* beans were collected
Table 1: Standard conditions for Atomic Absorption Spectrophotometer and safe limits of heavy metals in *Vicia faba* beans

Element	Standard conditions for AAS, λ [nm]	Safe limits [$mgkg^{-1}$ d.w.]	References
Pb	217.0	0.2	[5]
Cd	248.3	0.05 0.1	[14] [4]
Cu	324.8	10 40	[4] [7]
Ni	232.0	-	-
Zn	228.8	100	[13]

The graphical representation of Principal components analysis (PCA) using transposed standardized data is presented in figure 2 and it is suggesting that the heavy metals: lead and nickel present high contamination potential for the *Vicia faba* beanssamples species available on the Romanian market (*figure 2*).
PCA as a statistical technique was chosen to find the characteristic patterns of heavy metals data in the analyzed samples.

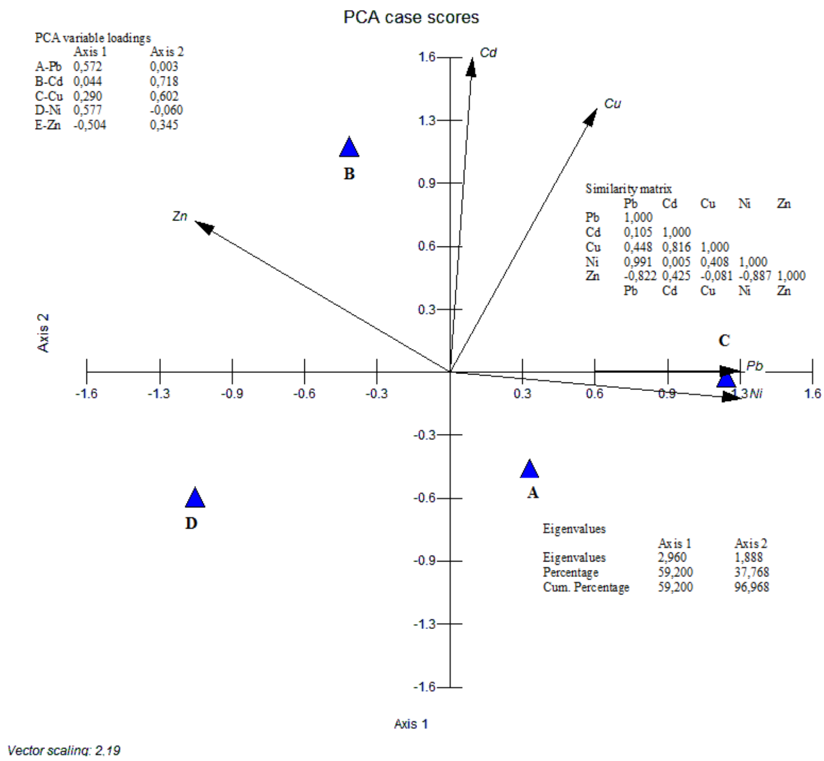


Figure 2. Biplot of the principal component analysis of heavy metals content data

Conclusions

Heavy metals analysis is of big importance in vegetables and fruits, but in special in plants with high accumulation potential like beans, peas, root vegetables, cabbage, tomatoes and nuts. Statistical analysis reveals the tendency of broad beans to be a good bio accumulator of nickel.

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